FIRST ESTIMATES OF THE STATUS OF BLACKTIP STOCK OFF THE EASTERN COAST OF THE US

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Summary

The status of the stock of blacktip shark in the western North Atlantic was assessed using an age-structured population dynamics model in a Bayesian statistical framework. The model was run under different assumptions about key biological parameters, such as pup survival at low population densities and combination of CPUE series. There were several problems with the convergence of the model under most of the scenarios considered when the input data adopted in the data preparation workshop were used. For this reason, some changes were made in the input data after discussion during the stock assessment workshop. The results with the updated set of input values are presented here.

Methods and Data

An age-structured population dynamics model is used for the calculations and the uncertainty in model parameters and input data is taken into account using Bayesian statistical methods. The age-structured population dynamics model used in the analysis is the same as that used for the estimation of the status of the sandbar shark off the eastern coast of the US. A full description of the model can be found in the relevant document (SEDAR11-AW-04). The catch and CPUE series used are shown in Tables 1 and 2, respectively. The values of the input parameters of the model are presented in Table 3. Two different sets of values for survival at age are included in that Table. The second set of values ("updated survival") is the new set of values adopted during the stock assessment workshop. Prior distributions for four uncertain parameters were used as an input in the analysis although not all of them were used in all the runs conducted. The four parameters are: Virgin population biomass, Pup survival at low population densities, and commercial and recreational historical catches. The model assumes virgin conditions prior to 1975. The priors for the historical commercial and recreational catches are used to describe catches between 1975 and 1981 when the model assumes that exploitation takes place between 1975 and 1981. The priors used for the estimated input parameters are:

- Virgin Biomass: Uniform on log(B) in the range [10^5 Kg, 10^9 kg]
- Pup survival (base case): Lognormal (0.75, 0.3^2) in the range [0.25, 0.99]. This is the new prior adopted in the stock assessment workshop
- Historical commercial catches: Normal (20000, 20000^2)
- Historical recreational catches: Normal (20000, 20000^2)

The constant of proportionality, $q_{j,k}$, and the lognormal standard deviation for residual errors between the observed and predicted values for each CPUE series, $\sigma_{j,k}$, are also uncertain parameters. Non-informative priors were used for those parameters.

The selectivities that characterise each of the catch and CPUE series are shown in Figure 1. It has been assumed that the selectivity that corresponds to commercial catches is the same as the one for unreported catches. The selectivity that was used for all the CPUEs used for the base case run was the same as that assigned to the commercial fishery.

Runs

Case 1. *Base case*: The first 4 CPUE series shown in Table 2 were used for the base case run together with the catch data shown in Table 1.. Also, equal weight was given to all CPUE series used. The number of pups per female was equal to 3.2.

Case 2. The same as above but with the alternative PLL CPUE series (only years 1995-2004)

Case 3. The same assumptions as those used under the base case but with all the CPUE series shown in Table 2.

Projections

The population was projected into the future under no exploitation to calculate the time it will take for the population to recover. The assumption used for those runs was that the same catch quotas as the 2003 quotas were in place for years 2005-2007. No fishing was allowed after 2007.

Results

The results of the model for the status of the stock when the values of the input parameters at the mode of the joint posterior pdf were used are shown in Table 4. The results of the projections for the recovery time are also shown in the same Table. The base case run gave the most pessimistic results about the status of the stock predicting that the population is overexploited and overexploitation is taking place. This run also gave the most pessimistic predictions about recovery time. The fit of the model to the four CPUE series used for the Base Case run is shown in Figure 2.

When the model was run using the same assumptions and CPUE series as in the base case but excluding the first three points from the PLL CPUE series the predictions of the model about the status of the stock were more optimistic than under the base case run. The model still predicted that the population was overexploited but the current size of the population was greater than that predicted under the base case scenario. The predictions of the model about the status of the stock when all the CPUE series were used (Table 2) were also more optimistic than the predictions under the Base case (Case 3). However, the size of the population under this run was slightly smaller than the B_{MSY}. Therefore, the population will recover in 8 years if exploitation is not allowed after 2008.

Table 1. Catches of blacktip shark in number of fish.

Year	Commercial +Unreported	Recreational
1981	550.8087	4497.919
1982	550.8087	28049.54
1983	595.0172	29298.93
1984	812.605	16099.45
1985	754.7884	53266.58
1986	4172.172	13626.29
1987	8572.724	46659.54
1988	4025.429	19662.38
1989	3871.738	21792.8
1990	4896.054	7173.501
1991	75319.21	40613.47
1992	97190.18	19626.81
1993	71521.71	12824.44
1994	81244.34	15940.77
1995	66294.76	19430.74
1996	41900.93	27866.7
1997	36023.26	16336.28
1998	32417.63	21499.24
1999	6807.34	8849.698
2000	9666.534	6753.017
2001	9654.326	14944.76
2002	20633.79	5276.609
2003	18355.26	30062.78
2004	13396.95	4277.895

Table 2. Indices used in the analysis. The indices labelled "base case" were used for the base case run. Some of the sensitivity runs included all the indices used in the base case run plus the indices labelled "sensitivity". The updated PLL CPUE series is shown.

YEAR	**GL Obs**	**BLLOP**	**BLL Log**	**PLL**	**SC LL Recent**	**NMFS LENE**	**MRFSS**
	Base case				Sensitivity		
	CPUE 1	CPUE 2	CPUE 3	CPUE 4	CPUE 5	CPUE 6	CPUE 7
1981	0	0	0	0	0	0	0.531
1982	0	0	0	0	0	0	1.186
1983	0	0	0	0	0	0	1.145
1984	0	0	0	0	0	0	1.285
1985	0	0	0	0	0	0	1.427
1986	0	0	0	0	0	0	0.755
1987	0	0	0	0	0	0	0.578
1988	0	0	0	0	0	0	0.567
1989	0	0	0	0	0	0	0.421
1990	0	0	0	0	0	0	0.748
1991	0	0	0	0	0	0	1.243
1992	0	0	0	3.389	0	0	0.523
1993	0.455	0	0	2.373	0	0	2.264
1994	0.955	0.805	0	2.019	1.750	0	1.039
1995	0.419	2.042	0	0.924	0.808	0.202	0.986
1996	0	1.246	0.678	0.785	2.094	0	0.515
1997	0	0.131	0.474	0.603	0.487	1.578	1.183
1998	1.286	0.534	0.689	0.360	0.482	0	0.536
1999	1.384	0.426	0.423	0.411	1.147	0	0.877
2000	1.286	0.153	1.005	0.392	0.232	0.797	1.730
2001	1.001	0.971	1.620	0.263	0.000	0	1.196
2002	0.982	4.578	1.948	0.434	0.000	0	1.249
2003	1.029	0.004	1.081	0.494	0.000	1.423	0.969
2004	1.204	0.111	1.083	0.550	0	0	0.531
Selectivity function							
	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial	"2-7"

Table 3. Model input parameters

Parameter	**Value**		
Time step	3 months		
	females		*males*
Age at 50% maturity a_{50}	6.4 years		4.6 years
Age at 95% maturity a_{95}	8.2 years		6.4 years
$a_{\max}$	20 years		
Survival from natural causes of death	Survival	Updated survival	Age
	0.75	0.8	1
	0.78	0.83	2
	0.80	0.85	3
	0.81	0.87	4
	0.82	0.88	5
	0.83	0.88	6
	0.83	0.89	7
	0.84	0.9	8
	0.84	0.9	9
	0.85	0.9	10
	0.85	0.91	11-15
	0.86	0.92	16-20
K	0.16		0.209
L_{∞}	158.5 cm FL		147.4 cm FL
t_o	-3.432 y		-2.586 y
Length transformations	FL(mm)=0.8301 STL-29.0042		
b_q	3.1253		
d_q	2.512×10^{-9} length in mm (STL), weight in Kg		
Fecundity	3.2 pups		
Reproduction frequency	2 years		
Gestation period	1 year		
Sex ratio	1:1		
Pupping season	June		

Table 4. Model predictions (modal values) under the different scenarios considered

PARAMETER	BASE CASE	CASE 2	CASE 3
Virgin biomass (kg)	22507533	24797927	29111418
Virgin number of fish	1287054	1417981	1664560
Pup survival	0.77	0.76	0.81
N_{2004}/N_v	0.18	0.27	0.41
B_{2004}/B_v	0.17	0.25	0.39
SSN_{2004}/SSN_v	0.16	0.25	0.38
MSY (kg)	264998	287530.9	357603.5
H_{2004}/H_{MSY}	4.55	2.8	1.5
B_{2004}/B_{MSY}	0.39	0.59	0.91
Recovery time	43 years	36 years	8 years
Historical recreational catches (# of fish)	19668.	19737.98	20746.09
Historical commercial catches (# of fish)	19146	19325	19011.49

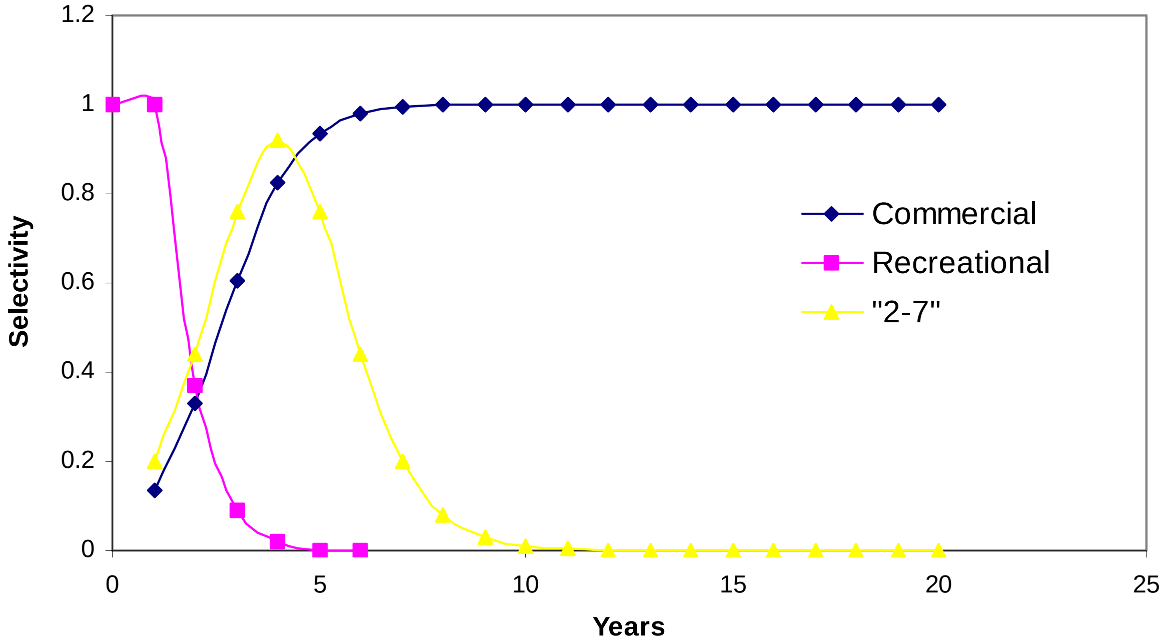

Figure 1. Selectivity of the different gears used in the analysis (see Table 2)

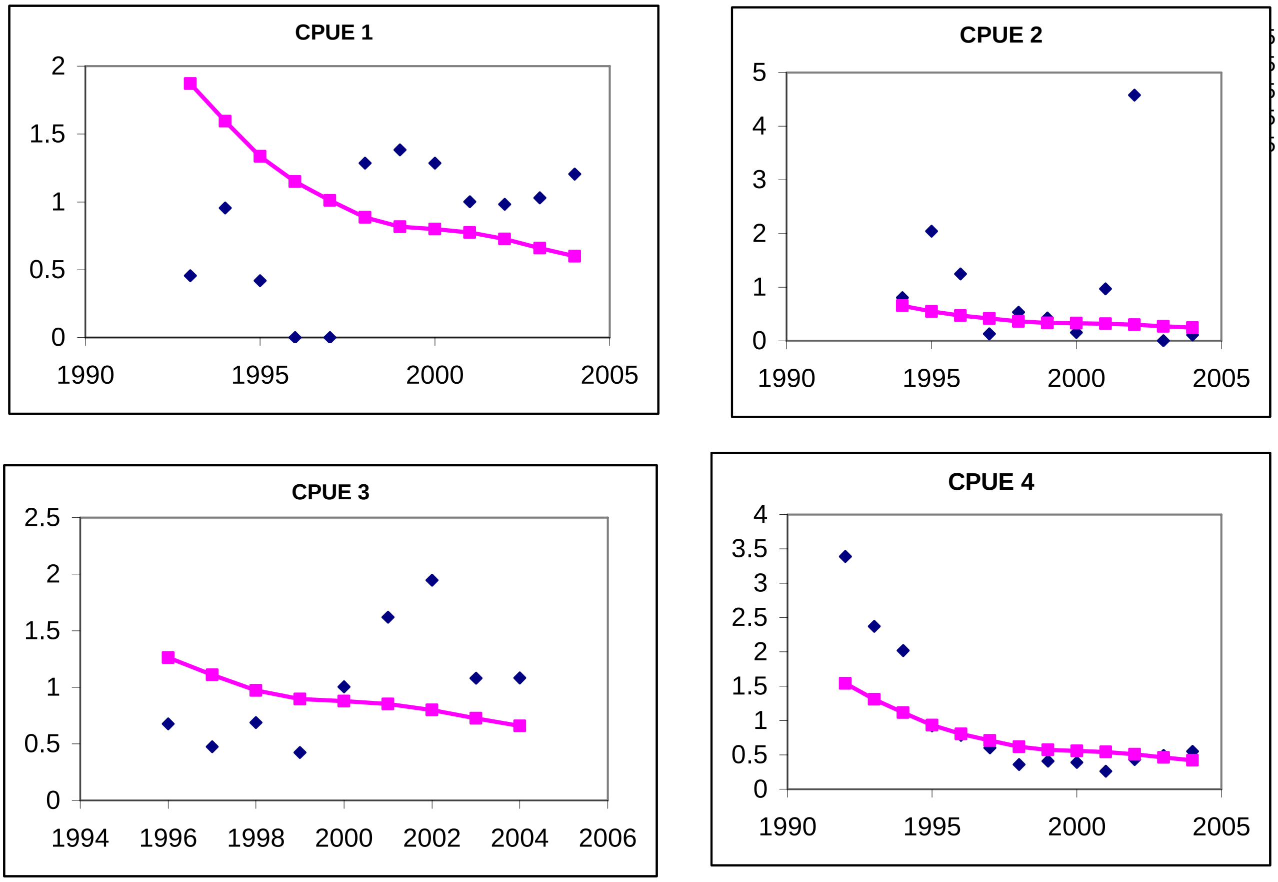

Figure 2. Fit of the model to the CPUE series used in CASE 8 for the values of the estimated input parameters at the mode of the joint posterior distribution. See Table 2 for the names of the CPUE series.